A Socio-Economic Assessment of Climate Vulnerability

"The Risk Is Real"

Abhinandan Dubey
SBU ID: 110872892
Stony Brook University
New York, USA

Teja Madiraju
SBU ID: 110798794
Stony Brook University
New York, USA

April 2017

Abstract

Climate change poses real and present danger to the future of the world. Also at stake is practically every major life form's existence that resides on this planet. Primarily, addressing climate change requires developing awareness in peoples' minds. We want to devise a time-series model on the socio-economic factors contributing to climate change, and predict future conditions if human actions proceed as they do today. More generally, we plan to create an interface which provides visualizations to trigger climate-aware thought-processes and provides some useful insights through basic statistical and machine learning methods.

1 Background

It is estimated that climate vulenreability will displace 250 million people by 2050 [5]. A more shocking fact is that if everyone in the world lived the way people do in the U.S, it would take five Earths to provide enough resources for everyone [3]. Additionally, thirty seven percent of Americans believe that global warming is a hoax, and 64 percent don't believe that climate change will seriously affect their way of life. [4] The greater problem is how nations choose to tackle this problem of climate change. There have been around 2,950,000 publications on climate change according to Google Scholar. Although most of them produce interesting results, a majority of them fail to attract attention of the general populace through simple media like interactive visualizations. We intend to achieve a part of this function through the present experiment.

2 Project Goals

The project aims at performing a thorough analysis of Climate Change and Socio-economic datasets made available by the World Bank OpenData Bank. We plan to find relations between factors affecting climate change, and produce thought-provoking visualizations to increase awareness. Also, through the power of learning theory, **We want to devise a time-series model that presents the socio-economic factors contributing to climate change, and predict future conditions if human actions proceed as they do today. We would like to do this through interesting visualizations providing vivid representations and run-throughs of data that has been collected over many years by different sources.** Thus, we will produce interactive plots that show different factors against each other in a time-lapse charts using D3js. We're planning to go live once we're done with the results.

2.1 Why This is an Important Problem

- Most of the research on climate change has been limited to papers and mathematical figures. It fails to provide interactive visualizations for people to see.
- Possibly, there are interesting relationships between factors leading to or affecting climate change. It would be interesting to find out these relations.
- Machine Learning methods can allow us to model the conditions and predict the future. This has been done before, but what makes our project different is the insights and visualizations that we will generate from this model.

3 The Datasets

We will be using various datasets from the World Bank's OpenData bank [1] and Berkeley Earth[2]. Some of these include:

- CO_2 emissions (metric tons per capita)
- Electric power consumption (kWh per capita)
- Energy use (kg of oil equivalent per capita)
- Forest Area
- Improved sanitation facilities (% of population with access)
- Mortality rate, under-5 (per 1,000 live births)
- Population growth (annual %) and Population, total
- Renewable electricity output (% of total electricity output)
- Literacy - School enrollment, primary and secondary (gross)
- Urban population (% of total)
- Average Annual Temperatures of all Land Area across countries - Berkeley Earth
- Registered vehicles - Data by country (WHO)

4 Implementation & Approach

Primarily, our aim is to find out correlations between Population, CO_2 emissions, and literacy. For achieving this, we divide this problem into two subproblems which deal with two kinds of factors.

4.1 Correlating Factors

These are factors that indicate the effect of climate change. Some consequential indicators include CO_2 emissions, Energy use per units of GDP, or per capita, average temperatures, urbanization and literacy. For these features, we have real datasets from World Bank which we can use to find correlations and build predictive models.

4.2 Causal Factors

They are factors that are the real cause for climate change, such as deforestation, agriculture, mining. These factors can probably account for any "shifts" or differences in expected and predicted values from our model.

First stage will involve running correlation tests such as the Dickey-Fuller Test and finding out if there are relations across the time series of different features. This stage will also involve data cleaning like using interpolating values for missing values etc.

The second stage will involve performing MDS for visualizing the level of similarity of countries with respect to some features, and treating various factors such as literacy rate,

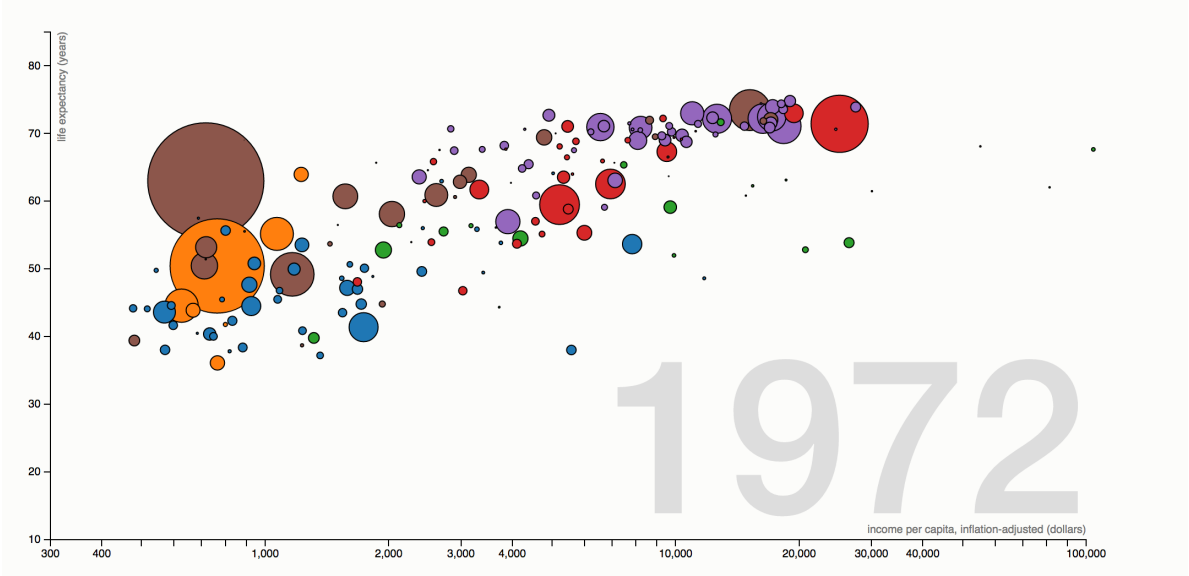

Figure 1: The Kind of Visualizations We're Aiming At

population growth and CO_2 emissions, we will train a Machine Learning model to predict the average temperatures across the land over time across the countries.

The third stage will involve visualizing results and answering questions such as how much the Earth will heat up, or how does the literacy rate affect the climate change, or how does the urbanization, agriculture affect the climate change. Them we will produce interactive visualization using D3js. One such visualization which can be used is https://bost.ocks.org/mike/nations/ - this visualization shows the dynamic fluctuation in values across time for multiple features in a simple way. One can mouseover the year to move forward and backwards through time

Backend: The backend will involve using Python, scikit-learn, Pandas, NumPy, SciPy.

Frontend: The frontend will be in HTML, CSS, Javascript and D3.js for visualization.

References

[1] The World Bank - OpenData "climate change". `http://data.worldbank.org/topic/climate-change`. [Accessed: 2017-04-02].

[2] Berkeley Earth Climate Science - time series data. `hhttp://berkeleyearth.org/data/`. [Accessed: 2017-04-04].

[3] Fast Facts About Climate Change - National Wildlife Federation. `https://www.nwf.org/Eco-Schools-USA/Become-an-Eco-School/Pathways/Climate-Change/Facts.aspx`. [Accessed: 2017-04-04].

[4] The Guardian - 'A tipping point': record number of Americans see global warming as threat. `hhttps://www.theguardian.com/environment/2016/mar/18/climate-change-record-concern-us-global-warming-poll`. [Accessed: 2015-04-10].

[5] UNHCR - The UN Refugee Agency. `http://www.unhcr.org/en-us/news/latest/2008/12/493e9bd94/top-unhcr-official-warns-displacement-climate-change.html`. [Accessed: 2017-04-10].